New ISS 1E Payload Development Process

Lessons Learned By Miniature Exercise Device 2 (MED-2) Project

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Outline

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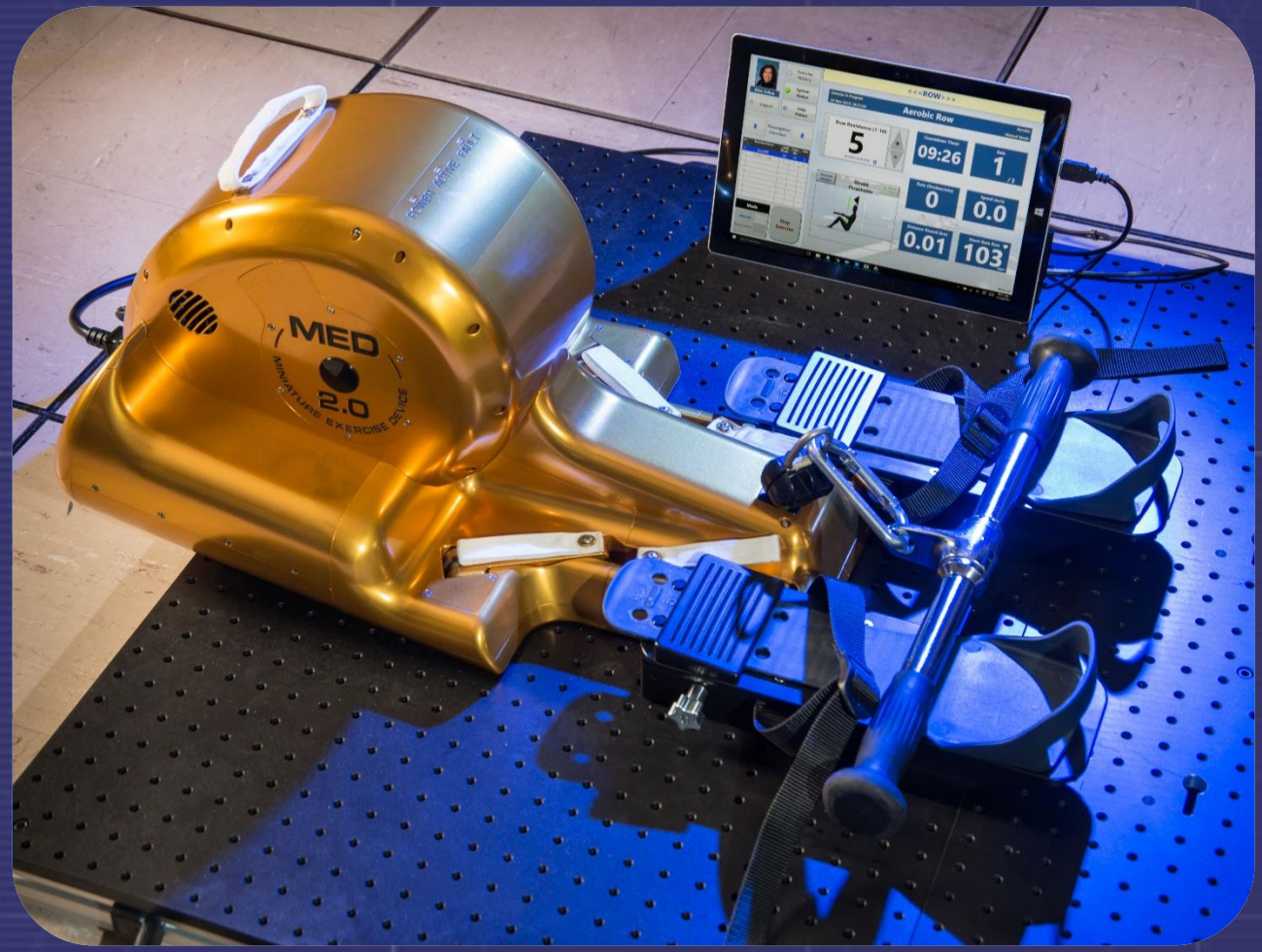

Class 1E Overview

- New flight hardware classification intended to streamline flight certification
  - Johnson Space Center (JSC) Policy Directive 7120.9
- Designation approved by project funding authority (FA)
- FA owns all risks and lifecycle costs
- Payload shall not perform mission critical functions
- Shall not compromise safety of crew, space vehicle or launch vehicle
- Requirements and other JSC Directives not applicable as directed in 7120.9
- Agile and lean development encouraged!

MED-2 Overview

- Selected as a JSC 5x2015 Project
  - Intended to be pathfinder projects for Class 1E hardware to ISS
- New archetype of exercise device
  - Combines aerobic (rowing) and resistive modes in one device
  - Compact and lightweight
  - Leverages technology developed by Software, Robotics and Simulation division (ER)
- Slated to be tested on ISS starting Summer 2016

MED-2 Timeline

- Authority To Proceed (ATP) February 2015
- Funding Available to project March 2015
- Engineering Unit (EDU) Design, Manufactured and Assembled July 2015
- Parabolic Flight with EDU September 2015
- ISS Safety Review Panel (ISRP) Phase III Completed Dec 2015
- Hardware delivery for flight on Cygnus OA-6 Jan 2016
- First planned used Inc 48/49 Summer 2016

Challenges

- MED-2 was one of the first Class 1E projects, and this required providing information on this new process to support orgs/facilities
- Fast project pace made it difficult to communicate decisions to all stakeholders
  - How/When to include all stakeholders in a timely manner was challenging
  - Project was unexperienced in developing flight systems and was not aware of certain stakeholders until deep into the development process
- Standard Center procedures, due to safety concerns, may have a specified timeline that sometimes was longer than entire Class 1E project duration

Challenges

- Project focused on developing, building and certifying hardware not entire lifecycle
  - Operational considerations not maintained in the forefront
- No central location for information dissemination
  - Project submitted the same information to several different organizations
  - Some organizations were operating with erroneous or old information not directly provided by the project

Successes - Safety Reviews

- Project combined Phases 0/I/II and had a Phase III divided in two parts
  - ISS Safety Review Panel (ISRP) agreed to reduce material submission time from 45 to 30 days (2 weeks time savings) per review
- Dividing the Phase III allowed the project to continue work and close out items on the design aspects that were not changing or completed
  - Time savings approximately 3 weeks since it allowed the Phase III review to start earlier
- Presented minor modification as Special Topic instead of Delta Phase III
  - Prior approval was obtained from ISRP
  - Expedited changes and certification

Successes - Analysis/Documentation

- Project requested Thermal and Stress analysis provide a memo instead of a formal report
  - Information was available to the project in a format that could be leveraged for reviews or certification 2-3 weeks earlier than normal
  - Time saved also reduced the cost of the report since there is less overhead and approvals required for a memo vs official report
- Safety Review Panel and other Boards accepted project signed memos as closure to verifications
  - Project provided Review of Design memos

Successes – Systems Engineering Integration and Testing

- Project coordinate all testing with facilities as non-controlled hardware
  - Simplified documentation
  - Project responsible for configuration control during all aspects of testing and transportation
- Project generated test reports for in-house testing
  - Used for verification and flight certification
- Project generated electronic assembly procedures
  - Easier to attach actual photographs, “live” notes
  - Assembly procedures automatically saved for historical purposes

Successes – Development Reviews

- Project did not follow traditional PDR, CDR, SAR processes
  - Used Peer Reviews and Technical Interchange Meeting (TIM) approach
  - No traditional SAR performed
- TIM approach allowed for a more open discussion between stakeholders and project
- MED-2 Project owns requirements

Summary

- Class 1E designation grants Project Manager (PM) a lot of flexibility during project development
  - Risk posture should dictate what procedures/tests to perform and which not to perform
  - Agile development allows for miscues to be remedied quickly
    - Challenge in documenting all decisions and changes accurately
    - Must inform all parties in a timely manner to ensure changes do not surprise stakeholders
- Pre-coordination with facilities and review boards is vital to ensure that level of information detail is declared and satisfactory

Summary (cont.)

- Payload Integration Manager (PIM) is vital to ensuring hardware gets to ISS
  - Information flow between PM and PIM must be constant and open
  - PIM can help with flight related roadblocks
- Generating a central information repository for outside entities to access would minimize misinformation
  - Important in fast paced projects
- Launch and On-orbit operations must be addressed early on